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SPACE PROPULSION TECHNOLOGY DIVISION



NEP TECHNOLOGY - FY 92 MILESTONES
(NASA LERC)

THRUSTERS

- o ESTABLISH 100 H TEST CAPABILITY FOR 100 KW MPD THRUSTERS
- o DEMO LIGHTWEIGHT 20-KW KRYPTON ION THRUSTER
- o OPTIMIZE THE DESIGN OF LOW-MASS POWER PROCESSOR TRANSFORMERS

NEP FACILITIES

- o COMPLETE EPL'S TANK 5 CRYOPUMP UPGRADE

Presented by: Jim Sovey
NASA Lewis Research Center



SPACE PROPULSION TECHNOLOGY DIVISION



NEP TECHNOLOGY - FY92 RESOURCES
(NASA LERC)

THRUSTERS

- o \$129K, MPD THRUSTER TECHNOLOGY
- o \$18K, TANK 5 CONSUMABLES
- o \$23K, ION OPTICS
- o \$30K, WITH \$35K (BASE R&T) FOR PPU MAGNETICS, UNIVERSITY OF WISCONSIN

NEP FACILITIES

- o \$40K, TANK 5 CRYOPUMP UPGRADE

NEP - ION THRUSTER TECHNOLOGY
(NASA LERC)

ACCOMPLISHMENTS.....THRUSTER

- o PERFORMANCE OF VIBRATION WORTHY 50-CM DIAMETER THRUSTER DESIGN COMPARABLE TO SOA DESIGNS
- o LIGHTWEIGHT 30-CM THRUSTER ASSEMBLED UNDER BASE R&T PROGRAM
- o 16 PAIRS OF DISHED ACCELERATOR GRIDS ARE NOW BEING FABRICATED.....TESTING SCHEDULED FOR FEBRUARY 1993.

POWER PROCESSOR

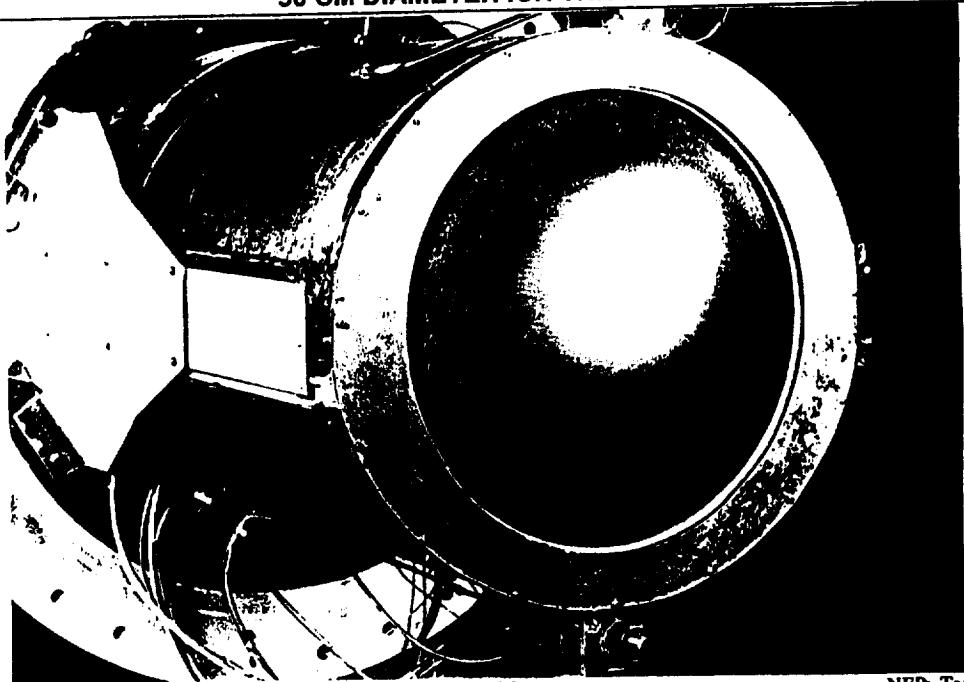
- o ANALYSIS OF FULL-BRIDGE, LOW VOLTAGE DC/DC CONVERTER COMPLETE
- o DETAILED ANALYSIS, TRADE-OFFS, AND DESIGN OF TRANSFORMERS COMPLETE
- o FOLLOW-ON WILL PROVIDE CONVERTER HARDWARE



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50 CM DIAMETER ION THRUSTER

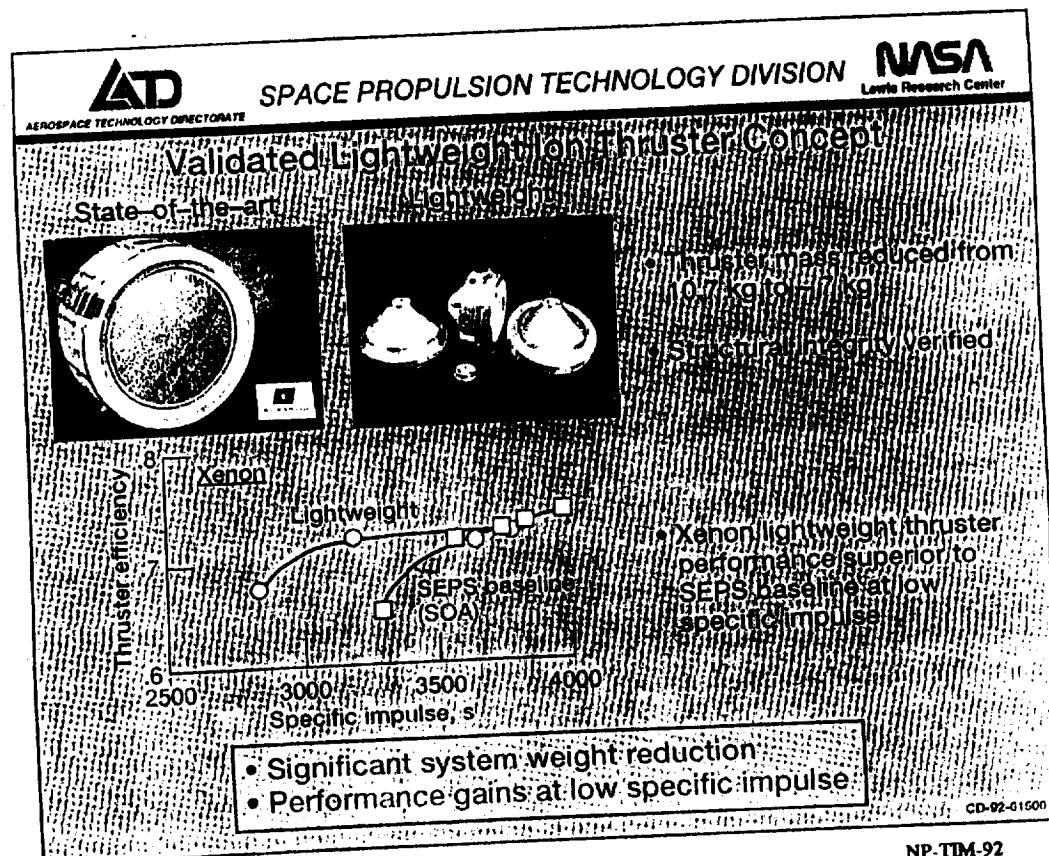
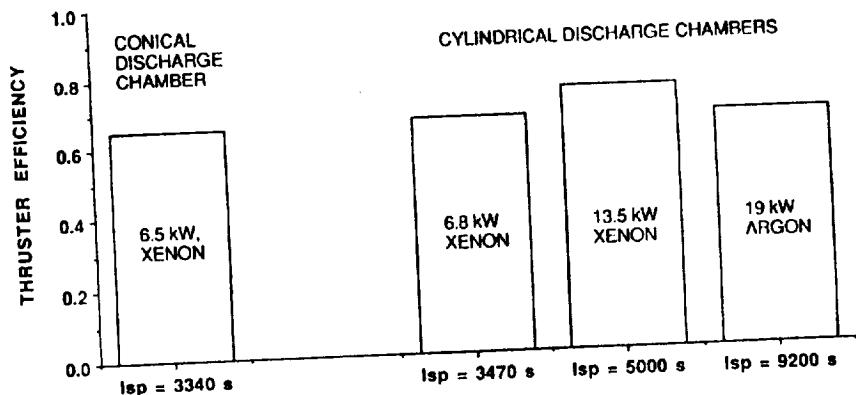


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NEP: Technology

50 CM DIAMETER ION THRUSTER PERFORMANCE

VIBRATION WORTHY CONICAL DIACHARGE
CHAMBER DESIGN HAS PERFORMANCE
COMPARABLE TO SOA CYLINDRICAL DESIGN





**LERC/JPL COORDINATED ION PROPULSION PROGRAM
SUPPORTED UNDER BASE R&T STARTING FY93**

LERC/JPL COORDINATED ION PROPULSION TECHNOLOGY PROGRAM

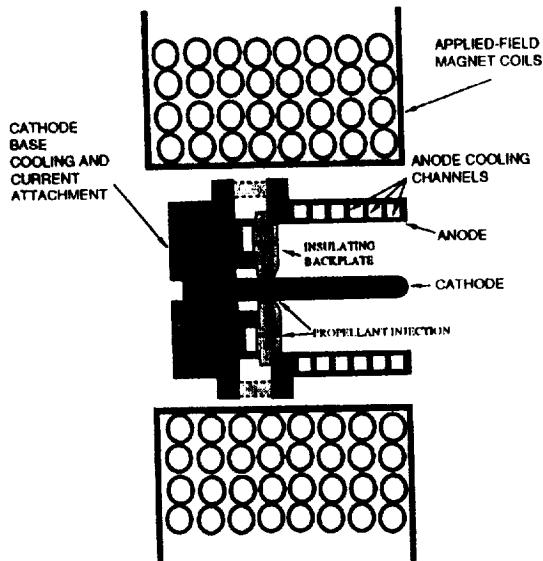
	FY93	FY94	FY95	AGENT (L: LERC, J: JPL)
1. THRUSTER DEVELOPMENT <ul style="list-style-type: none">o LIGHTWEIGHT 30 CMo POWER CONSOLE DEL.o SEG. THR. SYS. EVAL.o 5 KW SEG. THRUSTEIIo LIGHTWEIGHT 50 CMo DOWNSLECT THR. FOR SEP OR NEP	DOEING ^ AEROSP. ^ VIB, WFAIT ^ BOEING ^ AEROSP. ^ CSTAR ^ COMPLETE EXP EVAL ^ 1-SEGWEAR ^ 5-KW WEAR ^ HI-IMP, 25 KW ^ FAB COMPL.			L L J J L L, J
2. CATHODE DEVELOPMENT <ul style="list-style-type: none">o PROTOCOLSo DIAGNOSTICS/MODELS	DEFINE ^ THERMAL ^ PLASMA		^ LIFE	L (SSF) L (W, MPD)
3. GRIQ DEVELOPMENT <ul style="list-style-type: none">o CARBON-CARRONo 30 & 50 CM MOLYo DOWNSLECTo LASER DIAGNOSTICSo CHANGE EXCH. STUDY	^ 15 CM ^ HI PERV. CONTOURS ^ PRELIM MODEL	LOW WEAR	^ 30 CM EVAL ^ EVAL. HOLOGR. ^ IMPROVED MODEL LIFE PRED.	J L L, J L, J
4. POWER PROCESSOR <ul style="list-style-type: none">o COMPONENT TECH.o SIMPLIFIED PPUo PACKAGED PPU	LITE MAG. LAB DEMO	^ HV INVERTER LV BBS ^ DO DCMO SOW	^ HI POWER ^ COMPL. INTEL. ^ ATP	L L L J
5. BB FEED SYSTEM LIFE				
6. DIAGNOSTICS <ul style="list-style-type: none">o THRUST STANDo BEAM DIAGNOSTICS		^ COMPLETE ^ CIG. STATE	^ T-VICION ^ S/C EFF	L, J L, J

NEP - MPD THRUSTER TECHNOLOGY

FY 92 Milestone: Establish 100 hr test capability at 100 kW

Background:

- Base Technology Program supported extensive testing of
 - argon MPD thrusters to 240 kW
 - hydrogen thrusters to 100 kW
- Extensive performance data base established



Applied-Field MPD thruster schematic
Anode and cathode lengths of 7.6 cm. Cathode radius = 0.64 cm, anode radii of 2.54, 3.81, and 5.1 cm. Thrust exit plane was even with solenoid exit plane.



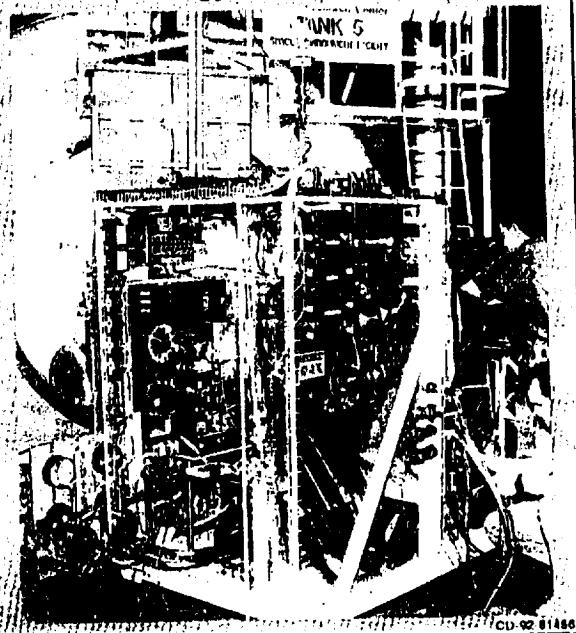
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High Power Electric Propulsion MPD Thruster Technology

- New facility established
 - Helium cryopumping
 - 350 kW power
 - Plume diagnostics
 - Electrode power diagnostics
- MPD thruster tested to 240 kW



CD-92-01486

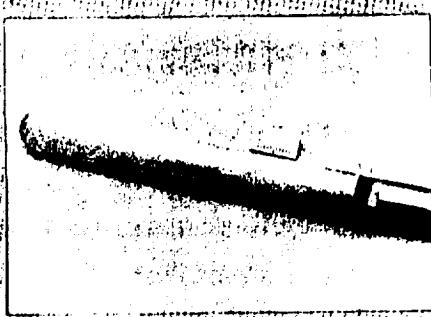


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MPD Thruster Lifetime Cathode Erosion

Backplate
location

- Low purity Argon (99.995%)
- No vacuum purge

- High purity Argon (99.999%)
- With vacuum purge

Major cause of cathode erosion eliminated

CD-92-01459
NPP: Technology



Applied-Field MPD Thruster Geometry/Operation Point Selection

Cathode

- Testing showed hollow cathode temperature was ~ 1000 K below rod cathode

Boron Nitride Backplate

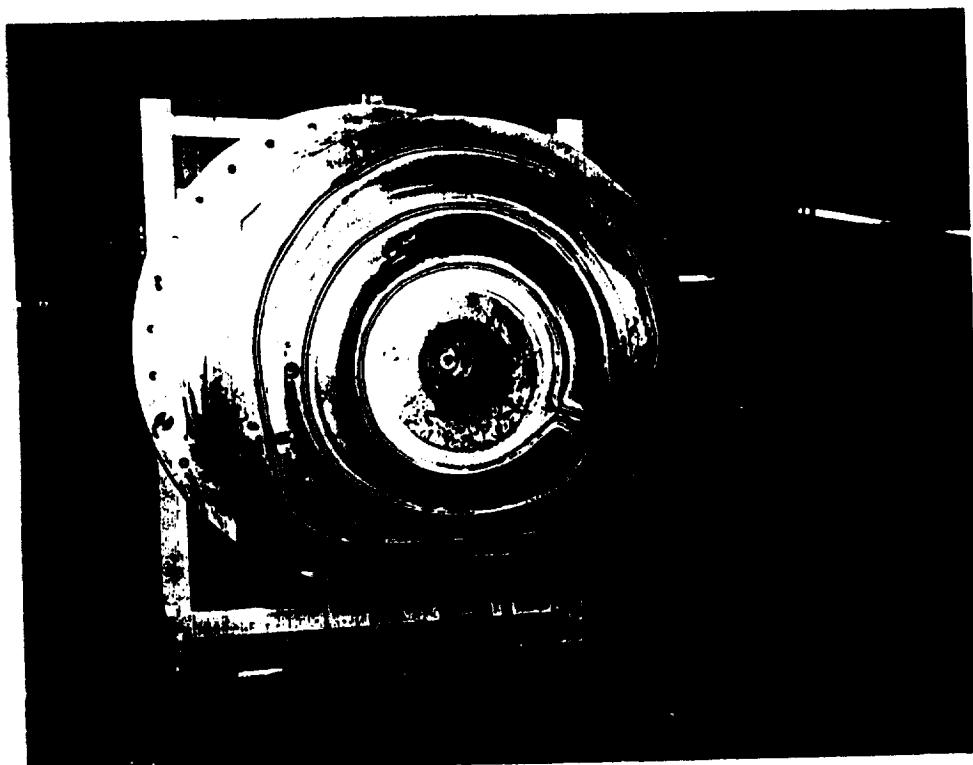
- Increasing cathode-to-backplate separation improved insulator life

Anode

- 5.1 cm radius, 15 cm long anode to reduce power density

Operating point

60 kW: 1400 amps, 47 volts
0.14 g/s argon





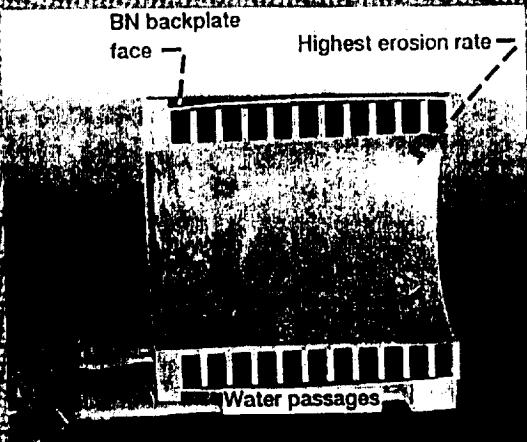
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MPD Thruster Lifetime Anode Erosion

Extended test conducted to identify first-order degradation limit



Sputtering by argon propellant identified as major cause of erosion
fundamental limit for Isp's of interest

Program emphasis shifted toward light propellants
and refractory metal anodes

Reference: J. Propulsion and Power, Vol. 2, No. 2, April 1986, pp. 111-114.